LLNL Environmental Restoration Division Standard Operating Procedure	TITLE: Suction Lysimeter Soil Moisture Sampling
APPROVAL Date _____ _____ Environmental Chemistry and Biology Group Leader	PREPARERS: S. Gregory and E. Walter REVIEWERS: L. Berg*, T. Carlsen, V. Dibley, J. Greci, and J. Hoffman*
APPROVAL Date _____ _____ Division Leader CONCURRENCE Date _____ _____ QA Implementation Coordinator	PROCEDURE NUMBER: ERD SOP-1.9 REVISION: 2 EFFECTIVE DATE: December 1, 1995 Page 1 of 11

*Weiss Associates

1.0 PURPOSE

To define suction lysimeter soil moisture sampling procedures that will ensure collection of a representative soil moisture sample from the vadose zone.

2.0 APPLICABILITY

This procedure applies to the collection of soil moisture samples for analysis. Soil moisture samples are generally used as an aid in tracking the migration of contaminated inorganic constituents through the vadose zone to the water table. The only chemical constituent for which suction lysimeters are currently being sampled is tritium at Site 300. Because of the use of pressurized air for sample retrieval, the use of suction lysimeters is not appropriate for the collection of volatile organic compound (VOC) samples.

3.0 REFERENCES

3.1 deVera, E. R., B. P. Simmons, N. D. Stephen, and D. L. Storm (n.d.), *Samplers and Sampling Procedures for Hazardous Waste Streams,* U.S. Environmental Protection Agency Report EPA-600/2-80-018.

3.2 Ford, P. J., P. J. Tarina, and D. E. Seely (1984), *Characterization of Hazardous Waste Sites A Methods Manual, 302. Vol. II of Available Sampling Methods*, 2nd ed., U.S. Environmental Protection Agency, EPA 600/4-84/076.

3.3 Korte, N. and D. Ealey (1983), *Procedures for Field Chemical Analyses of Water Samples*, U.S. Department of Energy, GJ/TMC-07, Technical Measurements Center, Grand Junction Project Office, Grand Junction, Colo.

3.4 Korte, N. and P. Kearl (1985), *Procedures for the Collection and Preservation of Groundwater and Surface Water Samples and for the Installation of Monitoring Wells: Second Edition*, U.S. Department of Energy, GJ/TMC-08, Technical Measurements Center, Grand Junction Projects Office, Grand Junction, Colo.

3.5 *National Handbook of Recommended Methods for Water-Data Acquisition* (n.d.), U.S. Department of the Interior.

3.6 National Council of the Paper Industry for Air and Stream Improvement, Inc. (1982), *A Guide to Groundwater Sampling*, National Council for the Paper Industry Technical Bulletin No. 362.

3.7 U.S. Environmental Protection Agency (USEPA) (1983), *Methods for Chemical Analysis of Water and Wastes*, EPA-600/4-79-020, Washington, DC.

3.8 USEPA (1985), *Practical Guide for Groundwater Sampling.* EPA/600/2-85/104.

3.9 USEPA (1986), *RCRA Groundwater Monitoring Technical Enforcement Guidance Document*, OSWER-9950.1.

3.10 USEPA (1986), *Test Methods for Evaluation of Solid Waste*, EPA-SW-846, Third Edition, Washington, DC.

3.11 USEPA (1992), *RCRA Groundwater Monitoring: Draft Technical Guidance*, Washington, D.C. (EPA/530-R-93-001).

4.0 DEFINITIONS

4.1 Lysimeter

A lysimeter is a water-permeable porcelain cup attached to a cylindrical polyethylene body fitted with two 0.25 in. metal tubes that permit surface access. Lysimeters are generally installed in the vadose zone at depths less than 40 ft. Application of a vacuum to the chamber of the lysimeter through the metal access tubes causes water from the surrounding soil (soil moisture) to flow from the soil pores through the porcelain cup into the lysimeter body. This water is then collected by applying positive air pressure to the chamber through one of the access tubes, forcing any collected water to the surface through the second access tube for sampling.

5.0 RESPONSIBILITIES

5.1 Division Leader

The Division Leader's responsibility is to ensure that all activities performed by ERD at the Livermore Site and Site 300 are performed safely and comply with all pertinent regulations and procedures, and provide the necessary equipment and resources to accomplish the tasks described in this procedure.

5.2 Field Personnel

The Field Personnel are responsible for properly performing lysimeter sampling in compliance with all applicable regulations and procedures to ensure that the samples and resulting data are representative of the actual conditions.

5.3 Sampling Coordinator (SC)

The SC's responsibilities are to generate and provide the sampling plan to the field personnel, ensure that the field personnel have been properly trained, and that they comply with all applicable regulations and procedures. The SC is also responsible for generating all applicable field sheets.

5.4 Study Area Leaders (SAL)/Facility Task Leader (FTL)

The SAL/FTL are responsible for the overall investigation, planning, and assessment and remediation within a study or treatment facility area and for providing the SC with input for the sampling plan.

6.0 PROCEDURES

6.1 Office Preparation

6.1.1 Review the Site Safety Plan and procedures.

6.1.2 Coordinate schedules with the SC.

6.1.3 If sampling at Site 300, check with the Site 300 Control Point Operator and Site 300 building supervisors for access to their areas, per SOP 4.1, "General Instructions for Field Personnel."

6.1.4 Check the following equipment for proper operation:

A. Air/vacuum pumps.

B. Vacuum and pressure gauges.

C. Gasoline-driven generator to be used with the vacuum pump. Wear gloves at all times when handling a generator, and dispose of gloves immediately after use.

6.1.5 Obtain equipment and supplies as listed in Attachment A, and load into the field sampling vehicle.

6.2 Field Preparation

6.2.1 Locate lysimeters to be sampled, and choose the most efficient sampling order. Sample from lowest contaminated area to most contaminated area.

6.2.1 Fill out initial information in Document Control Logbook per instructions in SOP 4.2, "Sample Control and Documentation."

6.3 Operation

6.3.1 Unlock the steel protective casing, and remove any dirt or debris from the gas-line fitting with a clean disposable towel.

6.3.2 Inspect the dedicated sample line for damage, and replace if necessary.

6.3.3 Attach a vacuum gauge (measuring centibars of soil suction) to the male quick-disconnect fitting attached to the lysimeter sanitary seal (Attachment B).

6.3.4 Connect the lysimeter's dedicated sample line to the vacuum port on the pump.

6.3.5 Plug the vacuum pump into the generator, and pull-start the generator (with the breaker switch off).

6.3.6 Open the air-intake valve on the pump, and turn the generator breaker switch on.

6.3.7 Slowly open the valve on the vacuum port in order to create a vacuum of 60 to 70 centibars. (This is generally sufficient to pull moisture from the surrounding soil material.) Watch the vacuum gauge closely so that the valve can be closed at the appropriate vacuum level. A vacuum release valve is attached to the vacuum port to prevent implosion of the lysimeter.

6.3.8 When the required vacuum is reached, close both the influent and effluent valves on the lysimeter. Turn off both the vacuum pump and the generator. The vacuum gauge may then be removed from the fitting on the sanitary seal.

6.3.9 Record all information on the Field Lysimeter Log (Attachment C), including the evacuation date and the vacuum level.

6.3.10 Do not disturb the suction lysimeter for 48 h to allow the moisture to be extracted from the soil pores.

6.3.11 After 48 h, attach vacuum gauge to the male quick-disconnect fitting on the seal. Open the valve, and measure the residual vacuum. Record this value and the sample date on the lysimeter log. Remove the gauge, and open the other valve.

6.3.12 If unforeseen circumstances arise and the vacuum on the suction lysimeter must remain past the 48 hours, it is acceptable to proceed in sampling. However, if the lysimeter does not yield an appreciable amount of water for analysis or it is dry and past history indicates that this should not be the case, a vacuum must be re-applied and the suction lysimeter must remain undisturbed for an additional 48 h before another sample can be drawn.

6.3.13 Attach an air line from the pressure side of the pump to the male quick-disconnect fitting.

6.3.14 Turn on the generator and pump, and open the pressure valve on the pump forcing a small amount of air pressure (30 to 40 pound per square in.) into the lysimeter chamber.

6.3.15 Any water in the lysimeter is forced to the surface and is collected from the dedicated sample line into the appropriate container (SOP 4.3, "Sample Containers and Preservation"). Any excess water is collected in a beaker or graduated cylinder so that total discharge volume can be determined. Record the residual vacuum, sample volume, excess volume, date and the technician's initials on the lysimeter field data sheet. Record all pertinent information (such as ID, date, volume, analysis, field and equipment conditions) in the Document Control Logbook.

6.3.16 Label samples, place in individual Ziploc-type bags, and store in a cooler until sampling is completed. Note: All tritium samples must be kept at 4˚C after collection for shipment per SOP 2.9, "Sampling for Tritium in Ground Water." Follow SOP 4.4, "Guide to the Handling, Packaging, and Shipping of Samples."

6.4 Field Post Operation

6.4.1 After all samples are collected, any non-dedicated sampling equipment should be decontaminated prior to sampling another site in order to prevent cross contamination of equipment or samples between locations (see SOP 4.5, "General Equipment Decontamination").

6.4.2 Conduct a cross-check of sample bottles in possession with those recorded in the logbook before leaving the sampling site. Because of the nature of the data being collected, the possession of samples must be traceable from the time the samples are collected until the final archiving of the resulting analytical data.

6.4.3 To maintain and document sample custody, follow the chain-of-custody procedures listed in SOP 4.2, "Sample Control and Documentation."

6.5 Office Post Operation

6.5.1 Arrange for delivery of samples. Specifics on sample shipment can be found in SOP 4.4, "Guide to the Handling, Packaging, and Shipping of Samples." Deliver or ship samples to the appropriate laboratory as soon as possible after collection. Store samples out of direct sunlight, and prevent freezing until delivery or shipment to the laboratory.

6.5.2 Deliver all field logbook notes, field forms, and copies or originals of chain-of-custody forms to the Data Management Group.

7.0 QUALITY ASSURANCE RECORDS

7.1 Document Control Logbook

7.2 Chain-of-Custody Forms

7.3 Field Lysimeter Sampling Log

8.0 ATTACHMENTS

Attachment A—Equipment Checklist

Attachment B—Suction Lysimeter Surface Hardware and Schematic

Attachment C—Field Lysimeter Sampling Log

Attachment A

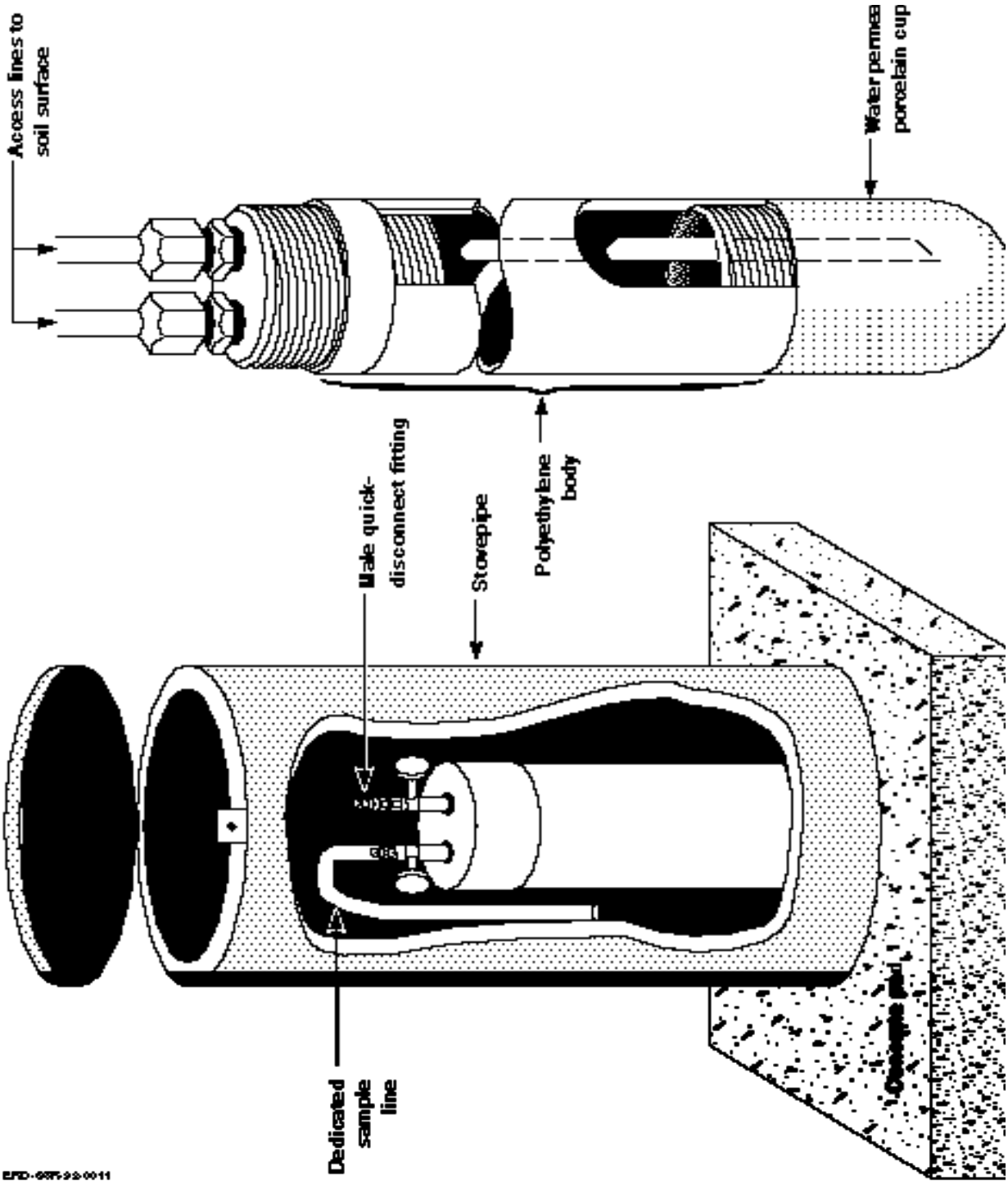
Equipment Checklist

EQUIPMENT CHECKLIST

____ Generator
____ Two-way radio
____ Thomas electric air pump/vacuum pump
____ Vacuum gauges
____ Beaker/graduated cylinder
____ Tool kit
____ Sample labels
____ Sample containers
____ Ice chests and ice
____ Ziploc-type bags
____ Padding for packaging of samples
____ Extra fittings and sample lines
____ Trash bags
____ Document control logbook
____ Vinyl gloves
____ Disposable towels
____ Any additional field supplies per SOP 4.1, “General Instructions for Field Personnel”
____ Extension Cord
____ Snake Chaps (when necessary)
____ Field Data Sheets
____ Appropriate maps

Attachment B

Suction Lysimeter Surface Hardware and Schematic


Access lines to soil surface
Water permeable porcelain cup
Male quick-disconnect fitting
Stovepipe
Polyethylene body
Dedicated sample line

Attachment C

Field Lysimeter Sampling Log

LYSIMETER DATA

LYSIM. NUMBER	DATE EVAC	VAC LVL	SAMPLE DATE	RES. VAC.	SAMPLE VOL.	EXCESS VOL.	INIT.
K1-03A							
05A							
K7-08A							
NC2-02							
03							
04							
NC7-01							
02							
03							
04							
05A							
06							
07							
08							
09							
13							
32A							
32B							
39A							
39B							
42A							
42B							